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Eastern slope of the Sierra from Oregon to Nevada and southern California; at 400 meters in California.

6b. CHYLISMA SCAPOIDEA CLAVAEFORMIS (Torr.).

OEnothera clavaeformis Torr. Frem. Rep. 314. 1845.

OEnothera scapoidea var. *aurantiaca* S. Wats. Proc. Am. Acad. **8**: 595. 1873.

Southern California and Arizona.

7. CHYLISMA BREVIPES (A. Gray).

OEnothera brevipes A. Gray, Pacif. R. R. Rep. 4: 87. 1857.

OEnothera clavaeformis Torr. Bot. Mex. Bound. Surv. 66. In part. 1859.

Southern California and Arizona.

Salix candida Willd, and its Hybrids.*

W. W. ROWLEE AND K. M. WIEGAND.

(PLATE 267.)

Within a radius of twenty miles of Ithaca, New York, there is but a single station for *Salix candida*. This is a swamp, formerly a sphagnous bog, called "Fleming Meadow," two miles south of the city. The swamp is a little higher, possibly fifteen feet, than Cayuga lake. An attempt was made some years ago to drain this and a neighboring bog and thereby to render them suitable for cultivation. The springs of water pouring in thwarted this attempt, and after they had been thoroughly cleared of bushes the attempt to utilize them was abandoned and they were allowed to become wild again.

Salix candida persisted along the margins of the ditches during the attempt to drain the bog. These have filled up and the soil has become again very wet. The willow has now spread somewhat from the ditches. Other willows grow in the bog. *Salix cordata* is more abundant than any other. *S. rostrata* and *S. dis-*

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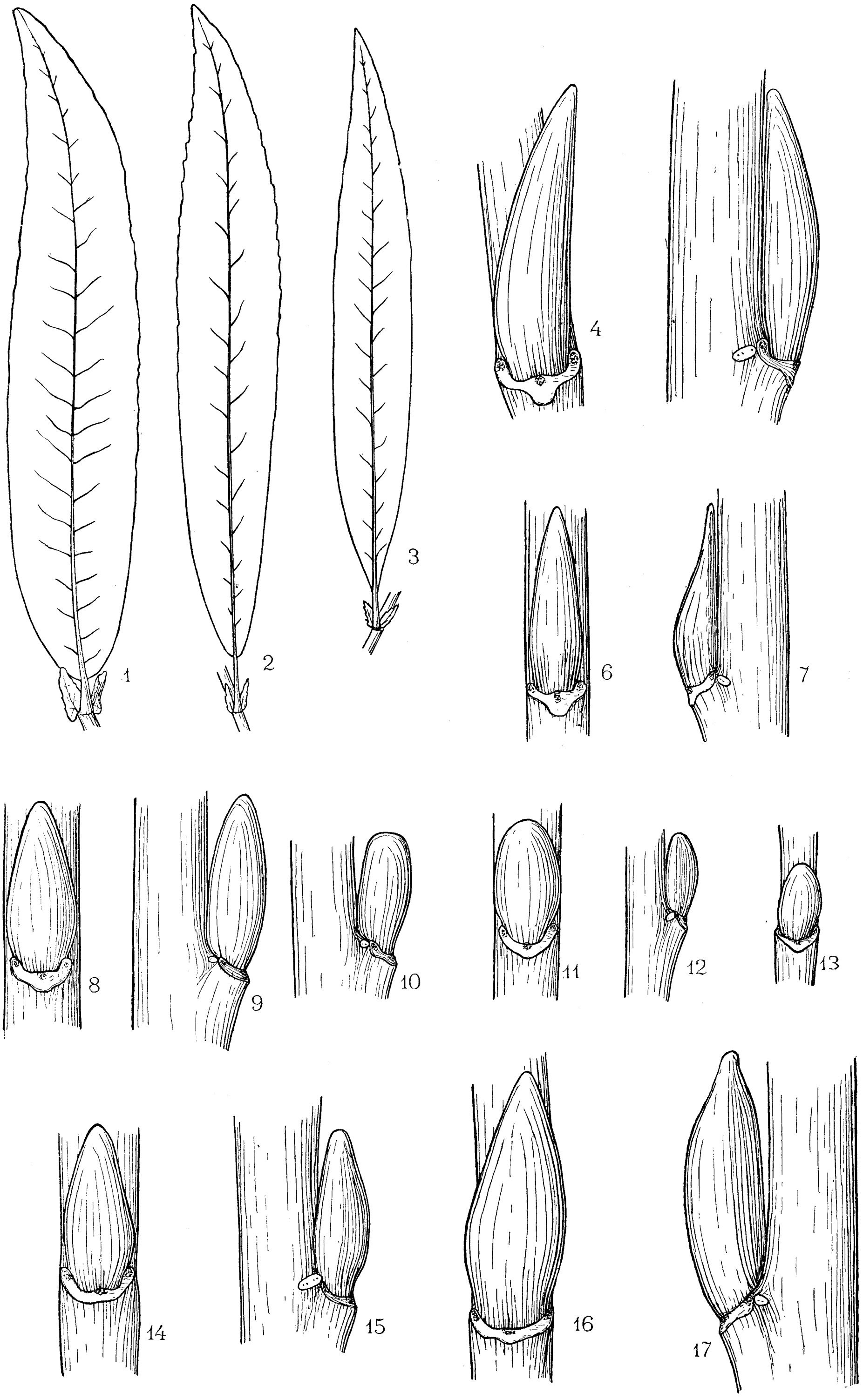
*We have received from the authors photographs illustrating the variation in buds described in this paper. They are willing to send similar photographs to anyone interested enough to pay the cost of printing and mailing—25 cents each. There are three photographs 5x8 inches, and 6 branches, natural size, represented in each.—ED.

BULLETIN OF THE TORREY BOTANICAL CLUB.—PLATE 267.



HYBRIDS OF SALIX CANDIDA.

color also grow there. *Salix sericea* grows in the immediate vicinity, but has not been detected in the bog. Stations for *S. petiolaris* are known not far from the bog, and it is highly probable that both the species last mentioned grew in the bog before vegetation was disturbed by settlements.

In the spring of 1894 several forms of *Salix candida* were brought into the laboratory, one of which was so unusual in its appearance that specimens were sent to Mr. Bebb. These specimens were from the plant labeled No. 20. Of it in a letter he said, "just at a glance, without a careful examination of minute characters I should take your smoother form to be a hybrid, *Salix candida* X *S. petiolaris*. In addition to the differences from pure *candida* which you mention, you will observe that the aments are borne on slender and more distinctly leafy peduncles. I imagine too that they are more loosely flowered. The capsules are too old to afford a good view of the style (without soaking up, for which I have not the time at present), but I fancy it is shorter than pure *candida*. The leaves have a different outline, being more pointed at base, and exhibit (even in your carefully dried specimens) a slight tendency to blacken, and the margin is less distinctly revolute. It would not be well to rest a decision on the scant material before me, but I have very little doubt that if you carefully study the forms in the locality from which this specimen was obtained, in flower, fruit and mature foliage, you will find convincing proof of hybridity."

Subsequent studies of these specimens during the same summer convinced us that there was a very interesting series of forms in the bog, and in the spring of 1895 a systematic study of them was undertaken. The opportunity for observing the forms is especially favorable, since the whole bog comprises not more than two acres, and the plants in question were all upon one corner of this area. Each individual which promised any appreciable variation from typical forms, as well as a number of apparently typical forms, was given a number and marked with a tag. At the same time a map of the locality was made as a check and as a matter of convenience in finding our plants. Observations were made at frequent intervals, and specimens were taken at three periods during the season: First, at anthesis (April 30); second, when the capsules were mature (May 17); third, when the leaves were mature (July 13). Specimens of the buds and branches were also taken in March, 1896.

The preliminary comparison of material from each individual, and our conclusions, together with a complete set of our plants, were ready to be sent to Mr. Bebb for his final revision, when the sad news of his death reached us.

The results of our work fulfil Mr. Bebb's prophecy and even more than fulfil it. A whole season's study of No. 20 confirms his provisional diagnosis of it.

There is a specimen from a pistillate plant in the Cornell University Herbarium named by Mr. Bebb, *Salix candida* × *S. petiolaris*, and on the label is printed, "Originally from Hascoll's Swamp, near Flint, Michigan, where it was discovered by Daniel Clarke, M. D., in 1872, the locality soon after being obliterated. Should it be deemed advisable hereafter to treat supposed hybrids as quasi-species after the manner of Andersson, Kerner and others, I very much wish that this beautiful Willow should be called *S. Clarkei*, to commemorate the name of a botanist who has done more than anyone else to give an impetus to the study of hybrid willows in this country." With the specimens are drawings and detailed notes which, so far as the writers know, Mr. Bebb never published.

Our plant differs decidedly from Mr. Bebb's in general appearance. The leaves are larger, much more densely tomentose below, and lighter green above; the capsules are much more densely tomentose at maturity (there is no young material with Mr. Bebb's specimen) and the tomentum is creamy white, whereas in his specimen it is silky and gray. The young catkins in our specimen have that glistening white appearance so characteristic of *S. petiolaris*. A superficial comparison of his plant with ours would lead one to believe them quite different, but closer examination shows that they agree quite closely as to essential characters. The winter buds, which are of much importance in diagnosing willows, indicate too that this is intermediate between *S. candida* and *S. petiolaris*.

It is a significant indication of the accuracy of Mr. Bebb's judgment regarding willows that what he anticipated for this specimen in style and capsule characters should prove so true.

There proved to be some other equally interesting forms in the same swamp. They are our nos. 21, 23, 28 and 84. Everything seems to point to these being hybrids between *Salix candida* and *S. cordata.*

No. 21 at time of flowering might easily be mistaken for pure *Salix cordata.* It is a staminate plant and has the large catkins and general aspect of *S. cordata.* The catkins are "sessile" as in *S. candida.* The young leaves are comparatively smooth, but even in age retain the "candida" characteristics very decidedly. The venation of the leaf resembles that of *S. candida* more than it does that of *S. cordata.* The leaves are lanceolate-acuminate as in *S. cordata.* The petioles are twice the length of the small stipules. The gall which is so abundant upon *S. cordata* in this region is abundant also upon this plant.

No. 23 is a pistillate plant. The capsules in the mature catkin (collected May 17) are acute and still bear the rather long style. They are sparsely tomentose and green and the sutures upon their sides are conspicuous. The leaves when young are densely-tomentose on both sides, the mature ones are whitened below and very veiny, those upon the lower part of the shoot being very sparingly tomentose, tapering nearly equally both ways and acute at both ends. The petioles are not longer than the stipules. The stipules are rather large, obliquely, very broadly ovate, acute and revolute. The winter buds are ovate, acutish, but rounded at the apex, divergent and only slightly flattened. The whole plant seems to be intermediate between its supposed parents.

No. 28 also a pistillate plant, is closely related to *S. cordata.* If it were not for the rugose, slightly revolute inconspicuously toothed, and somewhat tomentose leaves, the long styles and sparingly tomentose capsules, it would be at once so considered. The capsule becomes green and nearly smooth at maturity, but retains somewhat the form of the "candida" capsule. The form of the leaves and stipules, the leafy peduncled catkins, and the size of the plant are all suggestive of *S. cordata.* The winter buds also resemble those of the pistillate plants of *S. cordata*

No. 84 is also a pistillate plant. It bears a close resemblance to *S. candida.* In fact during our first visits to the swamp we took this plant to belong unquestionably to that species and did not give it a number. The appearance of the mature capsule led us to take specimens May 17th, and the leaves and buds confirm our surmise that this too is an errant form. A peculiar fact is that the plant resembles strongly *S. candida* in its floral and fruiting characters, while it resembles just as strongly *S. cordata* in its leaf and stem characters. The capsule is densely tomentose and the tomentum is in texture and color like that upon the capsules of *S. candida.* Older leaves are nearly smooth and are rugose above, whitened and silky below, the younger ones are covered with scattered white tomentum both above and below. The youngest leaves on the shoot which were still unrolled July 13th, are densely white-tomentose. The mature leaves are rounded at the base, with lanceolate-acuminate outline, and have revolute and very obscurely dentate margins. The stipules are obliquely ovate, broad and toothed, prominently veiny below and longer than the petioles.

No. 90 is another individual which is evidently intermediate between *S. candida* and *S. cordata.* Only the mature leaves and buds are available for study. These are sufficient to show that *S. candida* has some influence in this plant, although at time of flowering the plant was thought to be *S. cordata.* Another season's observations are necessary to determine the place no. 90 should have.

It seems very certain that these individuals are hybrids between *S. candida* and *S. cordata.* The isolation of the former species in this region and the very pronounced characteristics which it possesses makes it a comparatively easy matter to detect a relationship between the forms here described and the typical *S. candida.*

The other element in the mixture is not so constant and well defined. Mr. Bebb in his Notes upon N. A. Willows (Bot. Gaz. **16**: 104, 1891), says, "No American willow has a wider distribution than this (*S. cordata*). * * * * None other presents more the appearance of a 'congeries of species in the making.' * * * * Of all our willows, (it is) the one which hybridizes most freely with others, and this implies that even where actual hybridity cannot be proven, it is more or less effected by association with other willows in different portions of this wide area of distribution."

Of the inconstancy of *S. cordata*, Glatfelter (Trans. Acad. Sci. St. Louis, 7: 139, Jan. 4, 1896) states that of 184 specimens of supposed *S. cordata* which he collected at random near St. Louis, "13 were rejected as hybrid *sericea* and *cordata* either fully identified or probable." He also dwells upon the great variability of *S. cordata* and discredits Mr. Bebb's species *Salix Missouriensis*.

Professor Dudley spent much time studying willows about Ithaca. His conclusions (Cayuga Flora, p. 87), verified by Mr. Bebb, were that hybrids between *S. cordata* and related species were not infrequent. It has been a matter of some surprise that Professor Dudley or some other of the many students who have done field work about Ithaca did not discover these plants before. It hardly seems possible that they could have been passed over year after. It seems more probable that they have sprung up within the last ten years, perhaps immediately after the attempt to reclaim the swamp was abandoned.

Salix cordata as it grows about Ithaca is an exceedingly variable plant. It presents several forms and grows along the creeks and in low grounds everywhere.

The winter buds promise to aid much in the determination of species of willows *Salix cordata* and *S. candida* have very different buds. In the former they are large and flattened upon the side next to the branch and appressed. They are acute, the apex frequently reaching the base of the next bud above. They are dull and frequently hairy. In the latter the buds are short, rounded at the apex and decidedly spreading. They are polished and shining. The hybrids all have buds intermediate between the two species; they are more divergent, shorter, and more blunt than those of *S. cordata*, and vary from smooth to hairy.

Not until the winter buds came into consideration did the question of the parentage of our hybrids seem satisfactorily solved. Plate 267 illustrates forms of buds of *Salix candida* and *S. cordata*, and also the buds of the hybrids. The buds of the hybrid plants have the gradually contracted upper portion of *S. cordata*, but are inclined to be blunt. They are not always strictly intermediate between the two parents, but sometimes approach more nearly to one parent or the other. This variation is correlated with the relation of the hybrid to the parents as shown by other characters.

It should be noted, too, in this connection that several species show marked sexual variations in the buds and branches. The staminate plants generally have larger and stouter buds and coarser branches. No willow that has come to our attention presents so conspicuous sexual variation as *S. cordata*. The variation relates not only to the size of the bud, but also to the form.

It is highly desirable to prove experimentally that hybridization may take place between these willows, and that as an effect of such hybridization individuals will be produced like our forms. These experiments we propose to undertake. It does not seem desirable to await the result, since European willows, as well as American, are inclined to hybridize freely beyond a doubt, and our observations published may encourage others to report observations upon similar forms.

A detailed description may assist in identifying these forms when found in other places.

Salix candida Flügge × *S. petiolaris* Smith.

Catkins, at anthesis, 2 cm. long, at the time of dehiscence of capsule 4–5 cm., upon slender pedicels which bear two or three foliaceous bracts. The bracts not enlarging as the capsules mature. Catkins rather closely flowered at anthesis, moderately loosely flowered at maturity. Capsules, at anthesis, elliptic-lanceolate, 1 ½ mm. long, style 1 mm., smooth and purple, capsule densely white tomentose, stigmas conspicuously two branched, the apices of the branches two lobed. Pedicels ½ mm., about equalled by the slightly clavate gland, surpassed by the black scales; at maturity lanceolate, 6–7 mm. long and creamy whitish and tomentose, pedicels not longer than at anthesis, the looser character of the catkin being due to the elongation of the main axis.

Leaves narrowly elliptical, tapering very gradually to an acute base and apex, obscurely toothed and scarcely revolute, smooth and light green above, finely tomentose and very white and veiny beneath, petioles 1 cm. long, twice the length of small lance-subulate, revolute stipules. Young leaves showing a decided tendency to blackening in drying.

A shrub two or three feet high diffusely spreading, the young part of the shoots pruinose tomentose, becoming, in age, brown and polished. Buds ovate oblong, blunt, slightly compressed, bud scales chestnut or darker, nearly smooth.

Salix candida Flügge × *S. cordata* Muhlenberg.

Staminate plant. Catkins at anthesis 3 cm. long, stout cylindrical, bracts at base small or none. Scales obovate-spatulate, dark at tip, hair long and crisp.

Leaves 8–10 cm. long, narrowed elliptical, tapering each way from the middle, rounded at base, rugose and very prominently veined, serrulate, light green and mostly smooth above, whitened and somewhat woolly beneath; petioles 8–10 mm. long, slender, stipules ovate, semi-cordate inconspicuously veined ¼–⅓ length of the petiole. Shoot pale chestnut, often hoary. Buds ovate-lanceolate, rather blunt, stout and but slightly flattened. Numerous spherical galls formed of distorted leaves.

Pistillate plant. Catkins at anthesis 2 cm. long, leafy bracted at base. Capsule ½ mm. slender more or less tomentose, styles long or short. At maturity 2½–4 cm., more densely flowered and narrower than in *S. candida.* Capsule in the forms near *S. cordata,* ovate-lanceolate, tapering gradually to the short style, not obtuse, 3–4 mm., long, sutures glabrous and prominent. In forms near *S. candida,* the capsules are larger, 5–8 mm., more obtuse at apex, densely tomentose, sutures not prominent. Style slender, 1–1½ mm., more obtuse at apex, style more slender. Pedicel shorter, not twice the length of the gland scarcely over ½ mm. long.

Leaves large lanceolate, mostly rounded at base, 10–15 cm. long, 1½–2 cm. broad, narrowing to an acuminate apex, somewhat rugose, strongly veined, primary veins nearly horizontal, margins subentire, upper surface becoming glabrous, lower, whitish from nearly glabrous to tomentose. Petioles short, 3–5 mm., stout, stipules longer than the petioles, ovate to broadly ovate, subcordate, veiny, serrate, subacute and revolute.

Shoots long, light chestnut, slender, often tomentose, buds small, ovate, blunt, varying from narrow to broad, more or less compressed, divaricate or appressed.

CORNELL UNIVERSITY.

Explanation of Plate 267.

PLATE I. 1. Leaf of *S. candida* × *S. cordata.* 2. Of *S. candida* × *S. petiolaris.* 3. Of *S. candida.* 4–17. Winter buds collected in March. 4, 5. *S. cordata* (staminate). 6, 7. *S. cordata* (pistillate). 8, 9. *S. candida* × *S. petiolaris* (pistillate). 10, 11. *S. candida* (staminate). 12, 13. *S. candida* (pistillate). 14, 15. *S. candida* × *S. cordata* (pistillate). 16, 17. *S. candida* × *S. cordata* (staminate).